REMARKS/ARGUMENTS

Claim 14 is pending herein. Claim 14 has been amended hereby to correct matters of form and for clarification purposes, and to clarify that the ratio of the diameter of the ejection opening to a height of the hollow cylinder of the ejection side end portion is in a range of 0.4 to 4, as supported by Table 1 on page 21 of the specification, for example. Applicants respectfully submit that no new matter has been added.

1. Claim 14 was rejected under §112, first paragraph. Applicants respectfully traverse this rejection.

Claim 14 recites a method for ejecting liquid droplets from a liquid droplet ejection apparatus. Among other things, claim 14 recites a step of pressurizing liquid introduced into the pressurizing chamber from the liquid supply path via the liquid introduction bore and simultaneously ejecting a plurality of droplets of the liquid through the ejection opening of the ejection nozzle by actuating the piezoelectric/electrostrictive element such that a rate of change per unit time expressed as a ratio of an amount of change in a volume of the pressurizing chamber to a sum of the volume of the ejection nozzle and the volume of the pressurizing chamber is in a range of 6 ppm/μs to 40 ppm/μs.

The PTO asserted that the specification failed to teach how the term "ppm," as recited in claim 14 and paragraph [0053] of the specification, for example, represents a rate of change. The PTO also asserted that the ΔR ratio of ΔV/(Vn+Vk) would be unitless, or, if expressed per unit time, would have a microsecond $^{-1}$ value. Applicants respectfully disagree.

Applicants respectfully submit that paragraphs [0044]-[0054] of the specification describe the structures and conditions required to provide and actuate the liquid droplet ejection apparatus according to the method of claim 14, and Table 1 and paragraph [0055] show the desirability of providing the ΔR (rate of change per unit time expressed as a ratio) in the range recited in claim 14. ΔR is the change, per unit

time, in the ratio of $\Delta V:(Vn+Vk)$. While a ratio itself would technically appear to be mathematically unitless, as the PTO suggested, Applicants respectfully submit that the ratio is intended to represent a number that corresponds to a volume change amount that occurs over a designated period of time. In that manner, the numerical representation of the amount of change in that volume ratio over a certain period of time, such as one microsecond, would be that number (representing a volume) per microsecond.

Further, Applicants respectfully submit that the term "ppm" used in the specification and claim 14 is not a "parts per million" concentration unit. Rather, the term "ppm" in the present application means 1/1,000,000, much in the same manner that the term "percentage" (%) means 1/100. That is, instead of a percentage based on a scale of 100, the change in the ratio of the change in the volume of the pressurizing chamber to the sum of the volume of the ejection nozzle and the volume of the pressurizing chamber, per unit time, is expressed on a scale of 1,000,000. Applicants respectfully submit that one of ordinary skill in the art reading the present specification would readily understand how the claimed ΔR ratio and ppm/μs values are obtained and evaluated in the context of the present invention.

Applicants respectfully submit that the above explanations merely further clarify that which is already set forth in the specification, and that one of ordinary skill in the art would understand the claim terminology in the context of the present specification and the above explanations. For at least the foregoing reasons, Applicants respectfully request that the above rejection be reconsidered and withdrawn.

2. The §112, second paragraph rejection of claim 14 is noted, but deemed moot in view of rewritten claim 14 submitted above. Accordingly, Applicants respectfully request that the above rejection be reconsidered and withdrawn.

3. Claim 14 was rejected under §103(a) over Takeuchi (EP '491, assigned to the owner of the present application). Applicants respectfully traverse this rejection.

Claim 14 recites a method for ejecting liquid droplets from a liquid droplet ejection apparatus comprising the steps of providing a liquid droplet ejection apparatus which, among other things, is configured such that the ratio of the diameter of the liquid introduction bore to the diameter of the ejection opening is in a range of 0.6 to 1.6, and such that the ratio of the diameter of the ejection opening to the height of the hollow cylinder of the ejection side end portion is in a range of 0.4 to 4. The method also includes a step of pressurizing liquid introduced into the pressurizing chamber from the liquid supply path via the liquid introduction bore and simultaneously ejecting a plurality of droplets of liquid through the ejection opening of the ejection nozzle by actuating the piezoelectric/electrostrictive element such that the rate of change per unit time, expressed as ratio (ΔR) of the amount of change in volume of the pressurizing chamber (ΔV) to the sum of a volume of the ejection nozzle and the volume of the pressurizing chamber (Vn+Vk), is in a range of 6 ppm/μs to 40 ppm/μs.

Claim 14 was rewritten to address the §112, second paragraph rejection, as explained above, and to positively recite the structural features of the liquid droplet ejection apparatus that were previously recited in the preamble. Claim 14 was also rewritten to recite that the ratio of the diameter of the ejection opening to the height of the hollow cylinder of the ejection side end portion (i.e., d1/h1) is in a range of 0.4 to 4. This structural ratio is critical to the claimed method in order to enable the liquid droplet ejection apparatus to eject liquid in a mist-like form, as shown in Table 1 and as explained in paragraphs [0051] and [0052] of the specification, for example.

Paragraph [0052] of the present specification specifically teaches that when the d1/h1 ratio is less than 0.2, during the ejection, the contact resistance between the liquid and the inside wall surface of the ejection bore becomes excessively large, which decreases the ejection force and results in ejection defects. Table 1 on page 21 of the specification shows that ejection stability and mist-like liquid droplet ejection

conditions are best achieved when the d1/h1 ratio is at least 0.4 and when the ΔR ratio is in a range of 6 to 40 ppm/μs, as recited in claim 14.

The PTO acknowledged that Takeuchi does not disclose the claimed liquid introduction bore diameter/ejection opening diameter ratio or the claimed rate of change in the volume ratio, but asserted that it would have been obvious to try to optimize these ratios based on the disclosure in Takeuchi through routine experimentation. While Applicants disagree with the PTO's assertion, Applicants note that the PTO did not address the claimed d1/h1 ratio with respect to the applied references. Applicants respectfully submit, however, that this feature of claim 14 is simply not disclosed or suggested in Takeuchi.

That is, Applicants respectfully submit that the claimed (d1/h1) relationship corresponds to the inverse of the L/d relationship disclosed in Takeuchi (e.g., d/L). Applicants respectfully submit, however, that the d/L ratio of Takeuchi corresponds to a value that would not exceed 0.2, because Takeuchi specifically discloses that the L/d ratio must be 5 or more. Paragraph [0021] of Takeuchi explains that it is necessary for the ratio of the length L to the diameter d of the nozzle 2 to be at least 5, preferably 10 or more, in order to prevent air bubbles from entering, but that the ratio should not exceed 15, because a diameter that is too small can create obstacles during production. Since the L/d ratio of Takeuchi must be 5-15 for the reasons explained above, Applicants respectfully submit that the inverse of the L/d ratio (i.e., the d/L ratio) would be necessarily in a range of 0.2 to 0.066, which is always less than the claimed d1/h1 ratio of 0.4-4.

In view of the above, Applicants respectfully submit that the claimed d1/h1 ratio is simply not disclosed in Takeuchi. Moreover, Applicants respectfully submit that one of ordinary skill in the art would not have been motivated to try to modify Takeuchi's d/L to be at least 0.4, as claimed, given that Takeuchi clearly teaches that the d/L ratio would not exceed 0.2 because the L/d ratio must be 5 or more.

For at least the foregoing reasons, Applicants respectfully submit that Takeuchi does not disclose or suggest each and every feature recited in rewritten claim 14.

Accordingly, Applicants respectfully submit that claim 14 defines patentable subject matter over Takeuchi and respectfully request that the above rejection be reconsidered and withdrawn.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,

June 23, 2005
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